A critical appraisal of "Effects of training in minimalist shoes on the intrinsic and extrinsic foot muscle volume"

By

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Abstract

The aim of this critical appraisal was to assess the strengths and weaknesses found regarding the "Effects of training in minimalist shoes on the intrinsic and extrinsic foot muscle volume." As a runner myself, I was interested to find research that had been done on the subject of running using minimalist footwear. This study was done over the course of 6 months using a control group who remained in their traditional running shoes and an experimental group who transitioned into using minimalist running shoes. The study found that the control group had significant increases in both intrinsic and extrinsic foot muscle volumes at the end of the training period. These results supported the hypothesis posed by the researchers and showed a beneficial aspect that comes as a result of wearing minimalist running shoes. Because of the strengthening of the lower leg muscles that can occur, I determined that minimalist running shoes could be used as an intervention for runners to help strengthen the lower extremities and improve running form.

Key words

Footwear, shoes, minimalist, running, biomechanics.

Introduction

This critical appraisal was done for the course, *Evidence Based Practice in Physical Therapy*, at Angelo State University. The importance of this critical appraisal was to determine whether the findings of this study could be applicable in a clinical setting for runners in particular. With many people interested in minimalist footwear, this study provides good insight into some of the effects that are made to the body by wearing them. The clinical question posed was: *what are the effects of wearing minimalist footwear for runners?*

Methods

For the literature search process, the PubMed database, Cochrane Library, and CINAHL Plus were used to find articles relevant to the clinical question posed. The search terms included the following keywords: footwear, shoes, minimalist, and running. Searches were limited to articles from the year 2010 and onwards. The rationale behind this is that before 2010, the trend of minimal running shoes had not yet been as great. In total PubMed featured 51 hits, Cochrane Library had 18, and CINAHL Plus had 35 results.

The article chosen, "Effects of training in minimalist shoes on the intrinsic and extrinsic foot muscle volume," was published in the Clinical Biomechanics journal in May 2016. Tony Lin-Wei Chen, Louis K.Y. Sze, Irene S. Davis, and Roy T.H. Cheung are the authors of the article. The study was conducted at the Gait & Motion Analysis Laboratory, Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong. Of the articles found in searching, this particular one was chosen for critical appraisal because it could provide good insight for the clinical question posed. Additionally, its findings could be applied to help runners reduce the chance of injury.

Results

Summary of the study

The purpose of this study was to test the theory that running in minimalist running shoes would result in stronger intrinsic and extrinsic foot muscles. While there have been several previous studies that proposed wearing minimal running shoes would result in health benefits to runners, the strength of the intrinsic and extrinsic muscles after transitioning had not been tested. A randomized, single-blinded, and controlled study was done over the course of six months. Twenty runners recorded their training while transitioning to minimalist shoes and eighteen runners maintained the use of their traditional running shoes for the training. Intrinsic and extrinsic foot muscle volumes were recorded at the beginning and end of the experiment, using MRI scans to obtain the data. The results showed an increase in leg muscle volume of 7 to 9 percent for the experimental group that transitioned to minimalist running shoes. There was virtually no change muscle volume for the group who maintained the use of their traditional footwear. In conclusion, the increase in leg muscle volume was positively associated with the use of minimalist running shoes by the experimental group.

Appraisal of the study introduction

The introduction to the study provides a comprehensive overview of the reason for the study and does a good job at explaining the reported differences in the effects of minimal versus traditional footwear. The rationale was based on prior literature that theorized minimal running shoes would allow greater strain to the intrinsic and extrinsic muscles of the foot, thereby strengthening them. The title clearly describes the intent of the research and was addressed thoroughly in the introduction. The key words of the paper also match accordingly. Based on the

introduction, the dependent variables would be the intrinsic and extrinsic foot muscle volumes that were recorded. The independent variables would be whether the runners used minimalist or traditional running shoes for the duration of the study. Overall, the introduction was clear and well defined. There were no serious weaknesses found in the introduction.

Appraisal of the study methods

The research design was experimental. It was a randomized, single-blinded, controlled trial. The direction was prospective and the duration was cross-sectional. 55 subjects were recruited for eligibility in the study, with 8 being excluded. In total there were 47 participants, with 23 in the control group and 24 in the experimental group. Two groups were employed in the study. The experimental group underwent a training program in minimal running shoes, while the control group underwent the same training program but still using their own traditional running shoes. The subject's group assignment was blinded from the researchers. The runners were also unaware of the existence of the other group. The researcher who performed the measurements at the end of the study was also blinded to which group each subject was assigned. According to the study, the demographics of the subjects were all comparable. This included the runner's mass, height, weight, running experience, pacing, and weekly miles ran.

Weakness for the study methods would include the subject attrition that occurred over the course of the study with a total of 9 runners dropping out. 8 left due to scheduling conflicts, while there was 1 loss was due to lack of contact with the researchers. Another limitation could be if a shoe was used that provided more support and cushioning, but still met the criteria as a minimalist running shoe as defined by this study. This would alter the data and perhaps not challenge the muscles of the foot in the same manner.

Appraisal of the study results

The results section was clearly presented and well organized. The same order was used as was in the research questions and the procedures. The results appropriately addressed the original research question. The hypothesis that minimalist running shoes would strengthen the intrinsic and extrinsic foot muscles was supported by the data. The authors reported the outcome measures that were presented in the methods, this being the runner's intrinsic and extrinsic foot muscle volume after the study had ended. Both Table 1 and Table 2 were presented clearly and easy to interpret. The pre-training and post-training measurements were sorted nicely with the mean measurements for each group displayed. After the minimal running shoes transition, the volume changes for both the intrinsic and extrinsic foot muscles were statistically significant in the experimental group. EFM increased by 7.05% and IFM increased by 8.80%.

Weaknesses for the study results would be the large range of compliance found amongst the experimental group, with the average compliance only being 39.2%. This means the runners deviated from the distance in the training plan or wore traditional running shoes more than stipulated.

Appraisal of the study discussion

In the discussion, the authors further expounded upon the findings from the results and how they compared with other similar studies. They also discussed the relevance of foot muscle strength in regards to the medial longitudinal arch. The findings were tied into existing literature regarding minimal running shoes and their effect on foot muscle strength. All of the literature appears to be from credible journals and is current, being published within the past decade.

Lastly, the conclusions are reflective of the results. The increases in leg muscle volume found in the experimental group were associated with the use of minimal running shoes.

Limitations to the study were also recognized and mentioned in the discussion. There was a large range of compliance from the experimental group using the minimal running shoes. Participants reports of running mileage was done online, so it cannot be completely validated. Individual foot muscle volume was not measured, so a higher-quality MRI would be needed for further clarity. Lastly, different kinds of minimal running shoes could be used. The authors also stated that the relationship between foot muscle weakness and running injuries is still unclear.

Discussion

The clinical significance to current physical therapy practice could have many different applications. Because running is such a popular form of exercise, physical therapists will often deal with runners for the treatment of injuries that occur. It is reported that 37-39% of runners sustain an injury on a yearly basis. This study helps to answer my clinical question by demonstrating that there is a significant amount of growth in muscle volume that occurs over time by transitioning to minimalist footwear. For physical therapy patients, this study is useful to show them that wearing minimalist shoes can help to strengthen the intrinsic and extrinsic foot muscles. This could result in fewer injuries to runners by creating a more robust and stable base of support when interacting with the ground and resultant forces. Rather than relying on footwear for support, patients could come to understand that these muscles can be strengthened to help avoid and prevent injury.

My argument would be in favor of using the intervention appraised. The potential benefits of using minimal running shoes as an intervention in the clinic would include

strengthening both the intrinsic and extrinsic muscles of the foot. Another benefit would be relying less on the cushioning provided by traditional running shoes and gaining a better understanding of proper running mechanics. The risks involved in using minimal running shoes as a clinical intervention would be transitioning patients too quickly from traditional running shoes. Without a gradual transition, the chance for injury could increase due to the lack of external support that is provided by traditional running shoes in addition to weaker foot muscles. More research done to gain a better understanding of the relationship between foot muscle atrophy and the development of running injuries could improve the argument for using minimal running shoes to reduce injuries in runners.

While it is still uncertain whether minimal running shoes would be beneficial or detrimental, I believe the evidence found in this article could still prove helpful to runners who are dealing with persistent injuries. Because we live in a society in which our feet are forced into shoes from an early age, our feet do not develop in the same manner as they do in cultures who spend more time without footwear. With the elevated heel lift, narrow toe-box design, and added arch support typical of modern footwear, our feet conform to the confines they are given and can become weaker. As shown by this study, the use of minimal running shoes increases the volume of both the intrinsic and extrinsic muscles of the foot. I would have confidence in sharing the findings from this paper with a patient because of these beneficial effects. However, they would need to follow a slow transitional program to begin the use of minimal running shoes and know the risks involved. I could anticipate using minimalist running shoes as an intervention for runners safely in the future. It is a relatively simple intervention that many runners could potentially benefit from by removing some of the external support that the body has learned to rely upon that is given by traditional running shoes.

In conclusion, the findings show that there are beneficial effects that come from wearing minimalist running shoes and the validity of the research is good. However, more research is still needed to be done regarding the effects of minimalist footwear for runners.